The Applicability of the
Oil and Gas Stormwater Final Regulations
To Facilities That Process of Oil from Oil Shale and Tar Sands
(November 29, 2007)

ISSUE: Are operations associated with the extraction of oil from oil shale and tar sands exempt from the NPDES Stormwater (SW) rule for Oil and Gas Exploration, Production, Processing and Treatment operations (71 FR 33628, dated June 12, 2006)?

CONCLUSION: The existing stormwater rules, including revisions resulting from the Energy Policy Act of 2005, do not explicitly address whether facilities that extract oil from tar sands and shale oil are exempt from NPDES permitting. However, these types of activities are included in SIC Code 1311 for oil and gas extraction (and NAICS code 211, also for oil and gas extraction). These activities are not addressed under NAICS or SIC codes for mining activities.

As such, based on the available information, facilities that extract oil from shale and tar sands are subject to the CWA and NPDES regulations applicable to oil and gas extraction activities, not mining activities. As specified in the NPDES regulations, the applicability of permitting requirements for stormwater discharges from oil and gas activities is dependent on whether or not the stormwater is contaminated by contact with raw materials, intermediate products, finished products, by-product, or waste products and then a permit would be required if that site had a reportable quantity discharge of hazardous substances or oil or that discharge contributes to a violation of water quality standards

RECOMMENDATION: NPDES permit writers for facilities that extract oil shale or tar sands, either by surface mining or in-situ, should use BPJ to determine if stormwater from the site will become "***contaminated by contact*** with raw material, intermediate products, finished product, by-product, or waste products." An NPDES permit would only be required if the stormwater discharges had reportable quantities of hazardous substances or oil, or if there were reasonable potential for a water quality standard to be exceeded.

OTHER PERTAINENT INFORMAION: The State of Colorado does not provide for exemptions from permitting for certain oil and gas activities, including stormwater discharges from oil shale and tar sands operations

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BACKGROUND:

1. Statutory/Regulatory Review

a. Section 402(l)(2) of the Clean Water Act: The 1987 amendments to the CWA added language at section 402(l)(2) that exempts from NPDES permitting requirements certain storm water discharges from oil and gas exploration, production, processing, or treatment operations or transmission facilities. That provision in the Act states that "[t]he Administrator shall not require a permit under this section, nor shall the Administrator directly or indirectly require any State to require a permit, for discharges of storm water runoff from mining operations or oil and gas exploration, production, processing, or treatment operations or transmission facilities, composed entirely of flows which are from conveyances or systems of conveyances (including but not limited to pipes, conduits, ditches, and channels) used for collecting and conveying precipitation runoff and which are not contaminated by contact with, or do not come into contact with, any overburden, raw material, intermediate products, finished product, byproduct, or waste products located on the site of such operations

b. Section 323 of the Energy Act of 2005: Section 323 of the Energy Policy Act of 2005 added a new definition to section 502 of the Clean Water Act which reads as follows:

> "(24) OIL AND GAS EXPLORATION AND PRODUCTION. – The term 'oil and gas exploration, production, processing, or treatment, operations or transmission facilities' means all field activities or operations associated with exploration, production, processing or treatment operations, or transmission facilities, including activities necessary to prepare a site for drilling and for the movement and placement of drilling equipment, whether or not such filed activities operations may be considered to be construction activities…".

The term 'oil and gas exploration, production, processing, or treatment operations or transmission facilities' is used only in section 402(l)(2) as described above to define those activities exempt from NPDES permitting. However, the change in definition only affected construction activities associated with oil and gas field activities and operations.

c. 40 CFR 122.26(b)(14)(iii) – specifies that facilities classified under SIC codes 10 through 14 are considered industrial activity for purposes of defining sectors required to obtain NPDES permit coverage for stormwater discharges associated with industrial activity. [SIC 1311 includes both oil shale and oil sand mining, the two activities discussed herein. For SIC 1311, the SIC manual states "This industry includes the production of oil through the mining and extraction of oil from oil shale and oil sands…" As such, it is clear from the SIC designation, that oil shale and oil sand mining activities, while in some instances performing activities similar to mining, are in fact, considered oil and gas extraction activities, a category that is clearly covered by the 402(l)(2) exemption.] This section of the regulations notes that oil and gas exploration, production, processing, or treatment operations, or transmission facilities that discharge storm water contaminated by contact with or that has come into contact with, any overburden, raw material, intermediate products, finished products, byproducts or waste products located on the site of such operations are exempt from NPDES permitting requirements.

d. The final SW rule (71 FR 33631, dated June 12, 2006):

> 1) Applies to oil and gas exploration, production, processing, or treatment operations or transmission facilities and associated construction activities at oil and gas sites that are defined by the North American Industrial Classification System (NAICS) code 211 – Oil and Gas Extraction.

NAICS 211 includes facilities that produce crude petroleum from "surface shales or tar sands or from reservoirs in which hydrocarbons are semi-solids." (http://www.censusbureau.biz/epcd/ec97brdg/E97B1211.HTM) (Although mining is not mentioned in this description, it is mentioned in the description of facilities that fall under the Standard Industrial Classification (SIC) code 1311- Crude Petroleum and Natural Gas, which includes facilities that produce "oil through the mining and extraction of oil from oil shale and oil sands and the production of gas and hydrocarbon liquids through gasification, liquefaction, and pyrolysis of coal at the mine site.")

2) Clarified that the oil and gas exemption also applied to oil and gas construction activities even if a discharge caused a violation of water quality standards if that violation is attributable to sediment from the construction activities..

e. 40 CFR § 122.26(c)(1)(iii): 40 CFR 122.26(a)(2)(ii) sets forth permitting requirements for oil and gas activities by stating that all field activities or operations associated with oil and gas exploration, production, processing, or treatment operations or transmission facilities, including activities necessary to prepare a site for drilling and for the movement and placement of drilling equipment, whether or not such field activities or operations may be considered to be construction activities are exempt from permitting except in accordance with paragraph (c)(1)(iii) of this section. Paragraph (c)(1)(iii) establishes the criteria under which a permit is necessary, that being if the facility has had a reportable quantity release or the facility contributes to a violation of a water quality standard. Otherwise, a permit is not necessary for these oil and gas activities.

2. Definitions and General Information

Tar Sands

a. Tar Sands (also referred to as oil sands) are a combination of clay, sand, water and bitumen (a heavy black viscous oil). They can be mined and processed to extract the oil-rich bitumen, which is then refined into oil. The bitumen in tar sands cannot be pumped from the ground in its natural state. The tar sands must first be mined, which is accomplished by either using strip mining or open pit techniques. Alternatively, the tar sands can be processed in-situ by underground heating or other tertiary recovery processes.

b. Most of the world's oil (more than 5 trillion barrels) is in the form of tar sands.

c. Approximately one-third of the world's deposits are in Alberta, Canada, and Venezuela. Much of the rest is in the Middle East.

d. In the US, tar sands are primarily concentrated in eastern Utah. Resources are estimated at 12- 20 billion barrels and are mostly on public lands. (www.ostseis.anl.gov/guide/tarsands/index.cfm) About two tons of tar sands yield one barrel of oil. Roughly 90% of the bitumen is recovered. (www.fossil.energy.gov/programs/resources/npr/Tar_Sands_Fact_Sheet.pdf)

Oil Shale

a. Oil shale refers to any sedimentary rock that contains solid bituminous materials (called kerogen) that are released as petroleum-like liquids when the rock is heated by pyrolysis. (www.ostseis.anl.gov/guide/oilshale/index.cfm)

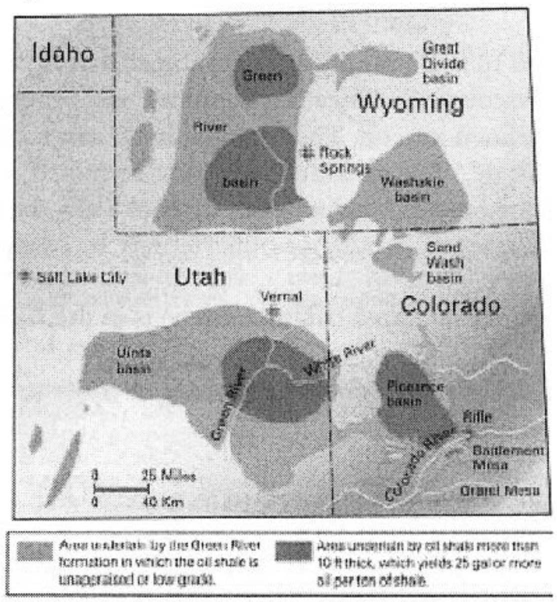
b. Kerogen can be converted to superior quality jet fuel and no. 2 diesel. The kerogen content of "oil shale" ore can range from 10 to 60 gallons of oil per ton.

c. The United States holds the world's largest known concentration of oil shale. More than three times the proven oil reserves of Saudi Arabia underlie a surface area of 16,000 square miles.

d. More than 70 percent of American oil shale (including the thickest and richest deposits) lies on Federal land, primarily in Colorado, Utah, and Wyoming. The estimated 800 billion recoverable barrels of oil in this shale formation are as much as the U.S. would use in 110 years, at current consumption levels.
(www.blm.gov/wo/st/en/prog/energy/oilshale_2.html)

d. There are also some less concentrated deposits in the eastern and southern United States. Eastern shales are more often silica based.
Oil Shale yields more than 25 U.S. gallons/ton.

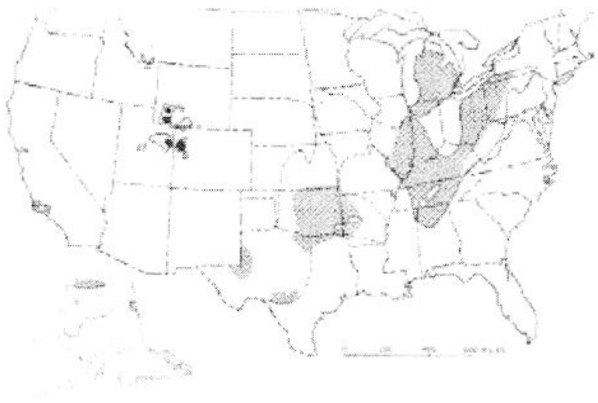
Figure 2 – Green River Formation Oil Shale Deposits



River Formation, underlies a 35 mile by 35 mile (1,225 sq miles) area of western Colorado.

(www.fossil.energy.gov/programs/reserves/npr/Oil_Shale_Resource_Fact_Sheet.pdf)

Figure 1 - Major U.S. Oil Shale Deposits



(www.fossil.energy.gov/programs/reserves/npr/Oil_Shale_Resource_Fact_Sheet.pdf)

3. Process Information

Both tar sands and oil shale can either be extracted using open mining or in-situ methods.

a. Recovery Technology for Tar Sands - the choice of recovery technology depends on the grade, viscosity and depth. Shallow, colder resources are more viscous, but may be surface mineable. Deeper, warmer resources are less viscous, but may require in-situ processes. (www.fossil.energy.gov/programs/reserves/npr/Tar_Sands_Fact_Sheet.pdf)

1). Surface or Open Pit Mining is used to recover tar sands near the surface.

i) Large hydraulic and electrically powered shovels are used to dig up the tar sands and load them into enormous trucks that can carry up to 320 tons per load.
ii) The tar sands are transported to an extraction plant, where hot a water process separates the bitumen from sand, water, and minerals. The separation takes place in separation cells.
iii) Hot water is added to the sand and the resulting slurry is piped to the extraction plant where it is agitated.
iv) The combination of hot water and agitation releases bitumen from the oil sand and causes tiny air bubbles to attach to the bitumen droplets that float to the top of the separation vessel, where the bitumen can be skimmed off.
v) The bitumen is then transported for processing into synthetic crude oil.
(www.ostseis.anl.gov/guide/tarsands/index.cfm)
vi) The spent sand and other materials are returned to the mine.
(http://en.wikipedia.org/wiki/Tar_sands)

2). In-situ methods are used on bitumen deposits buried too deep for mining to be economical. (www.ostseis.anl.gov/guide/tarsands/index.cfm)

i) Steam Injection-

a) *Cyclic Steam Stimulation*

(1) Steam is injected into a well at 572–752° F (300-400 °C) for a period of about two weeks.

ii) The well is allowed to sit for days to weeks or months, allowing the formation to soak up the heat.

iii) The hot oil is pumped out of the well for a period of weeks or months.

iv) Once the well production rate falls off, the well is put through another cycle of injection, soak and production.

b) *Steam Assisted Gravity Drainage*

i) Two horizontal wells are drilled in the tar sands, one at the bottom of the formation and another about 5 meters above it. These wells are typically drilled in groups off central pad and can extend for miles in all directions.

ii) In each well pair, steam is injected into the upper well.

iii) The heat melts the bitumen, which allows it to flow into the lower well.

iv) The melted bitumen is pumped to the surface.

2) Solvent Injection or the Vapor Extraction Process (VAPEX)-

Similar to Steam Assisted Gravity Drainage only hydrocarbon solvents are used. (This method is more energy efficient than using steam and allows the bitumen to become partially upgraded in the formation.)

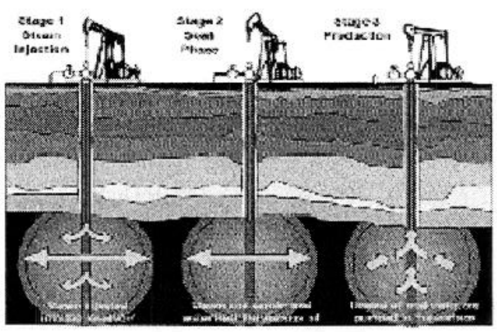
3) Firefloods or Toe to Heel Air Injection (THAI) –

Oxygen is injected and part of the resource is burned to provide heat.

a) Oil is allowed to ignite in the reservoir and creates and vertical wall of fire moving from the "toe" of the horizontal well toward the "heel".

b) The fire wall burns the heavier oil components and drives the lighter components into the production well. (http://en.wikipedia.org/wiki/Tar_sands)

Figure 2 – Cyclic Steam Injection



Source: www.fossil.energy.gov/programs/reserves/npr/Tar_Sands_Fact_Sheet.pdf

b. Recovery Technology for Oil Shale

i. Underground or Surface Mining

1) Oil shale is mined and transported to a facility for retorting.

2) Surface retorting involves crushing the mined oil shale and then retorting it at about 900 to 1,000 °F. The vessel in which this heating occurs is called a retort. (Source: Bartis et al., Oil Shale Development in the United States –Prospects and Policy Issues, National Energy Technology Laboratory of the USDOE, 2005, pg 13). Retort technologies include:

a) Internal combustion technologies
b) Conduction through wall technologies
c) Externally generated hot gas technologies
d) Reactive fluids technologies
(http://en.wikipedia.org/wiki/Oil_shale_extraction)

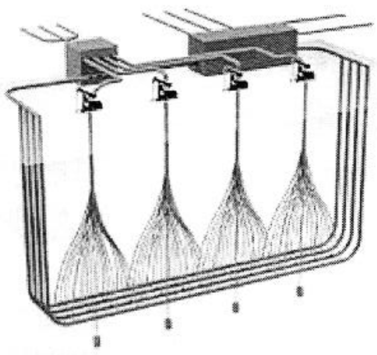
3) The gas and oil vapors are separated from the spent shale and collected, causing the oil to condense.
4) The oil may be used as fuel oil or upgraded to meet refinery feed specifications by adding and removing impurities like sulfur and nitrogen.
5) The non-condensable retort gas and char may be burnt and the heat energy may be reused for heating the raw shale or generating electricity.
(http://en.wikipedia.org/wiki/Oil_shale_extraction)
4) The spent shale is often placed back in the mine.
(www.ostseis.anl.gov/guide/oilshale/index.cfm)

ii. In-Situ methods (potentially can extract more oil from a given area of land than conventional surface mining)
1) True in-situ – do not involve mining the oil shale.
2) Modified In-situ – involve drilling and fracturing the target deposit above the mined area to create a void space of 20-25% which improves the flow of gases and liquid fluids through the rock formation. Some modified methods under development include:

a) Shell's in-situ Conversion Process (ICP) – under development in Colorado. A freeze wall is constructed to isolate the region to be retorted from surrounding groundwater. Wells 2,000 feet in depth and eight feet apart are drilled and circulated with a super-chilled liquid to cool the ground to -60 F. Water is then removed from the working zone. Heating and recovery wells are drilled on 40 feet spacing with the working zone. Electrical heating elements are lowered into the heating wells and used to heat the kerogen to 650 -700 F over a period of four years, slowly converting it into oil and gases, which are then pumped to the surface. See attachment for diagram of process.

b) Chevron CRUSH Process – injection of carbon dioxide into a formation via conventionally drilled wells and then exposed to the formation via a series of horizontal fractures where it would circulate around. The hydrocarbons would then be produced via conventional vertical oil wells. See attachment for a diagram of the process.

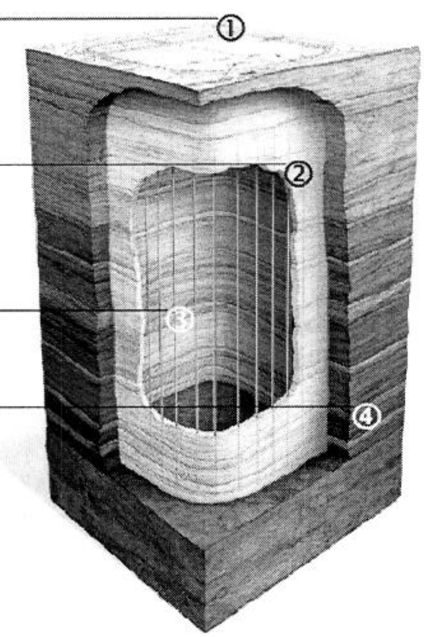
c) EGL Oil Shale Process – combines horizontal well (through which steam is passed) and vertical wells (which provide both vertical heat transfer through refluxing of generated oil and a means to collect and produce oil).



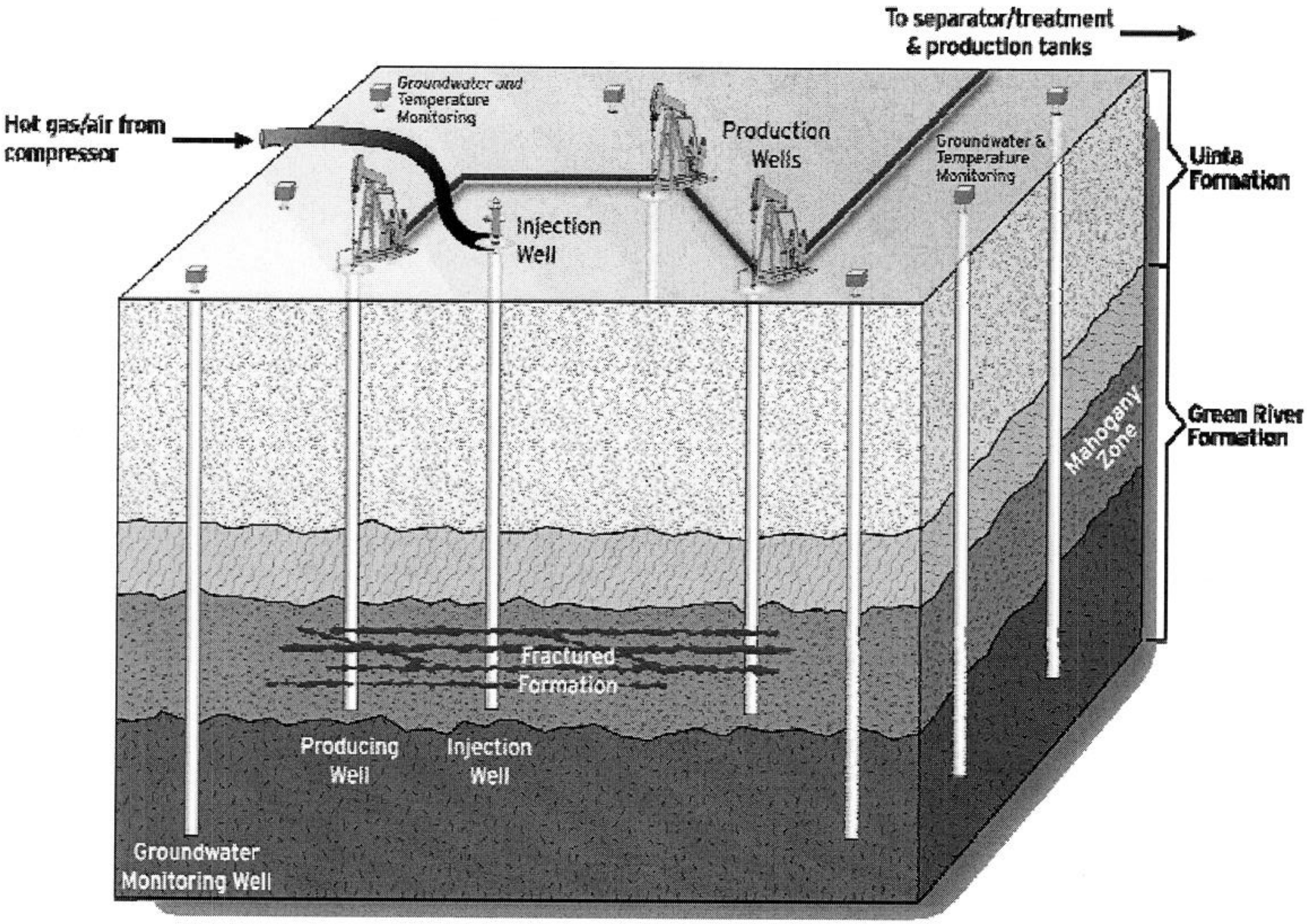
EGL Oil Shale Process (http://en.wikipedia.org/wiki/Oil_shale_extraction)

Shell ICP

1. **SURFACE FOOTPRINT** – Surface facilities for the freeze wall include access points to the closed-loop pipe system, monitoring wells and groundwater wells, which will pump out the groundwater from inside the contained reservoir once the freeze wall is built.
2. **ICE WALL** – A chilled liquid would be circulated through a closed system of pipes causing the water in the surrounding rock to freeze and eventually form a wall of ice. This freeze wall will serve as a barrier to keep groundwater out of the contained reservoir.
3. **HOLES** – Shell will drill a maximum of 150 holes spaced about 8 feet apart in order to create the closed-loop pipe system.
4. **SHALE BED** – Up to 2,000 feet beneath the surface, the shale layer is a rock formation containing organic matter (kerogen). It is this organic matter trapped in the rock that results in oil and gas when gradually heated. Shell's goal is to find a way to produce this potential energy resource in an economically viable, environmentally responsible and socially sustainable manner.



http://en.wikipedia.org/wiki/Oil_shale_extraction.



Chevron CRUSH process; http://en.wikipedia.org/wiki/Oil_shale_extraction